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## Red Hot Chili Pepper. A New *Calluella* Stoliczka, 1872 (Lissamphibia: Anura: Microhylidae) from Sarawak, East Malaysia (Borneo)

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### Abstract

A new brightly-coloured (olive and red) species of microhylid frog of the genus *Calluella* Stoliczka 1872 is described from the upper elevations of Gunung Penrissen and the Matang Range, Sarawak, East Malaysia (Borneo). *Calluella capsa*, new species, is diagnosable in showing the following combination of characters: SVL up to 36.0 mm; dorsum weakly granular; a faint dermal fold across forehead; toe tips obtuse; webbing on toes basal; lateral fringes on toes present; outer metatarsal tubercle present; and dorsum greyish-olive, with red spots; half of venter bright red, the rest with large white and dark areas. The new species is the eighth species of *Calluella* to be described, and the fourth known from Borneo. A preliminary phylogeny of *Calluella* and its relatives is presented, and the new taxon compared with congeners from Malaysia and other parts of south-east Asia.

**Key words:** *Calluella capsa* sp. nov., Microhylidae, systematics, new species, Gunung Penrissen, Matang Range, Malaysia

### Introduction

The microhylid genus *Calluella* Stoliczka 1872 comprises seven nominal species that are known from southern China, Indo-Malaya and Indo-China (Frost 2013; Inger *et al.* 1999; Das *et al.* 2004). The genus was created to place *Megalophrys guttulata* Blyth 1856, by Stoliczka 1872, originally described as a monotypic genus. With the exception of *C. guttulata* (Blyth 1856) and *C. yunnanensis* Boulenger 1919, members of the genus tend to be rare in collections, with most species known from three or less specimens. This rarity is perhaps due to their fossorial habits within rainforest habitats, and temporally limited appearance on the soil surface. Perhaps as a consequence, as many as three synonyms are on record: *Colpoglossus* Boulenger 1905 (for *C. brooksii* Boulenger 1904), *Dyscophina* van Kampen 1905 (for *C. volzi* van Kampen 1905) and *Calliglutus* Barbour and Noble 1916 (for *C. smithi* Barbour & Noble 1916). The genus *Calluella* was placed in the subfamily Dyscophinae along with the Madagascan *Dyscophus*, although Vences (2004) mentioned that molecular data have failed to clarify their relationship. Subsequently, *Calluella* was transferred to Calluellinae by Fei *et al.* (2005), and on the basis of phylogenetic position to Microhyliinae by Frost *et al.* (2006). More recently, de Sá *et al.* (2012) reported the genus, as currently construed, to be paraphyletic. Pyron and Wiens (2012) suggested a sister-relationship with *Glyphoglossus*, on the basis of sequence data, and together with *Glyphoglossus* and *Microhyla*, forming a well-supported clade within the Microhyliinae (McPartlin 2010).

Here, we describe an eighth species of *Calluella*, the fourth to be found on Borneo. We allocate the unique holotype to this nominal genus for showing the following diagnostic characters that are currently associated with the genus (see Parker 1934; Inger 1966 for diagnoses): head wide, with flattened body; eyes small; maxillary and vomerine teeth present; webbing on toes basal; lateral fringes on toes present; pupil circular; tongue large, oval and entire; paired dermal ridges across palate; lack of calcar on heels and elbows; lack of enlarged tubercles on hand; eye to snout distance less than twice eye diameter; tips of fingers not expanded into disks and a large compressed inner metatarsal tubercle under each foot, measuring over half length of Toe I.

## Materials and methods

The holotype was collected on 27 March 2012, photographed in life, euthanised and fixed in 10% formalin five days after collection and subsequently washed in water and transferred to 70% ethanol about a week after collection. The paratype was recovered dead and partially dried from a road in September 2012. It was rehydrated for 24 hours, fixed in formalin and transferred to 70% ethanol within a week of collection. Sexes of the type specimens were determined through dissection. The following measurements were taken with Mitutoyo™ dial vernier callipers (to the nearest 0.1 mm): snout-vent length (SVL, from tip of snout to vent); tibia length (TBL, distance between surface of knee and surface of heel, with both tibia and tarsus flexed); head length (HL, distance between angle of jaws and snout-tip); head width (HW, measured at angle of jaws); head depth (HD, greatest transverse distance of head, taken posterior of the orbital region); eye diameter (ED, horizontal diameter of the eyes); interorbital distance (IO, least distance between upper eyelids); internarial distance (IN, distance between outer rim of nostrils); eye to snout distance (E–S, distance between anterior-most point of eyes and tip of snout); eye to nostril distance (E–N, distance between anterior-most point of eyes and posterior rim of nostrils); width of upper eyelid (UE, greatest width of upper eyelid); axilla to groin distance (A–G, distance between posterior edge of forelimb at its insertion to body to anterior edge of hind limb at its insertion to body) and body width (BW, greatest width of body). In addition, measurements of digits were taken on the left limbs, from the base to tip. Colour recorded in digital images of the holotype were compared with colour swatches of F. B. Smithe (1975; 1981).

Sources of data on character states include: Barbour and Noble (1916), Berry (1975), Boulenger (1905; 1919), Fei *et al.* (1999), Inger (1966), Inger & Stuebing (2007), Kiew (1984), Liu (1950), Manthey & Grossmann (1997), Nieden (1923), Parker (1934), Taylor (1962), van Kampen (1905, 1923), Wu *et al.* (1987) and Yang (1991). Museum abbreviations follow Sabaj Pérez (2012) except for: Raffles Museum of Biodiversity Research, National University of Singapore, Singapore for which we use the acronym ZRC, following local usage; BMNH = The Natural History Museum London; DWNP = Zoological Museum of the Department of Wildlife and National Parks, Kuala Lumpur; FRIM = Forest Research Institute Malaysia, Kepong, Malaysia; and SM = Sarawak Museum, Kuching, Malaysia.

Partial sequences of the mitochondrial 16S rRNA gene were used to check for conspecificity of the two type specimens and to demonstrate their phylogenetic position within Microhylidae. Total genomic DNA was extracted from macerated muscle or liver tissue samples using Wizard<sub>SV</sub> Genomic DNA Purification System (Promega, Switzerland), according to the manufacturer's protocols. The following primers were used for PCR amplification: 16SC (forward) 5'-GTRGGCCTAAAAGCAGCCAC-3', 16SD (reverse) 5'-CTCCGGTCTGAACTCAGATCAGTAG-3' (Vences *et al.*, 2005). 25 µl PCR reaction volume was used containing 1 µl DNA, 1 µl of each primer (20 pmol/µl (20 µM), 1.5 µl MgCl<sub>2</sub> Magnesiumchlorid, 12.5 µl GoTaq<sub>Hot</sub> Start Green Master Mix (Promega) and 8 µl ddH<sub>2</sub>O (Promega). The cycling conditions for amplification were: denaturation at 94°C for 2 min; 35 cycles at 94°C for 0:30 min, 48°C or 50°C for 0:30 min, and 72°C for 1:00 min; then one final extension cycle at 72°C for 5:00 min, stop at 4°C. All PCRs were performed on a Techne TC-512 thermo-cycler. PCR products were excised from agarose gels and cleaned using the Wizard<sub>SV</sub> Gel and PCR Clean-UP System (Promega). Sequencing was done in both directions at LGC Genomics (Berlin, Germany) using the same primers mentioned above. Sequence editing and management was performed in Geneious Pro 6.1 (Drummond *et al.* 2009).

We compared our data of the new species (GenBank accession numbers KJ488544, KJ488545) with sequences of *Calluella* and of a few closely related genera, including *Chaperina*, *Glyphoglossus*, *Kaloula*, *Metaphynella*, and *Microhyala* available in NCBI GenBank and previously published in studies on the phylogeny of Microhylidae (e.g., de Sá *et al.* 2012; Matsui *et al.* 2011, accession numbers shown in Fig. 4). Following de Sá *et al.* (2012), we

selected *Kalophrynus* to root the tree. Sequences of the Bornean species of *Calluella* (*C. brooksii*, *C. flava* and *C. smithi*) are not available from GenBank. The 71 sequences were aligned using the MAFFT algorithm (Katoh *et al.* 2002) to obtain alignments with maximized sequence similarity (Morrison 2009). We used the MAFFT plug-in in Geneious Pro, with the E-INS-i mode and standard parameters set. We used PAUP via the PAUP-plugin in Geneious Pro to calculate the number of variable and informative characters in the final mdata matrix. Maximum Likelihood analysis (ML) was performed using web server-based version of RaxML 7.0.4 (Stamatakis *et al.*, 2008) with 100 rapid bootstrap inferences, the GTR model of sequence evolution, and the CAT model of rate heterogeneity. In RaxML only the GTR model is implemented (see RaxML manual, Stamatakis *et al.* 2008). All free model parameters were estimated by the software and the Maximum Likelihood search option was used to search for the best-scoring tree.

## Results

### *Calluella capsas*, new species

(Figures 1–2)

**Holotype.** UNIMAS P0610, at the road from the Borneo Golf and Jungle Resort (01.173889°N, 110.20000°E), Gunung Penrissen, Padawan, Sarawak, East Malaysia (Borneo), altitude 939 m ASL (GPS datum WGS 84), coll. Y. M. Pui, 28 March 2012. Adult male.

**Paratype.** UNIMAS 9389, from Summit Trail (ca. 01.673889°N, 110.166667°E), Kubah National Park, Matang Range, Sarawak, Malaysia, altitude ca. 700 m ASL (no GPS data taken), coll. V. Shakhparonov, 3 September 2012. Adult male.

**Diagnosis.** A mid-sized (SVL 34.2 and 36.0 mm in the two specimens known, both adult males) species of *Calluella*, sharing the following characters: body rounded, depressed; head wide; snout short; eyes small; tympanum covered with skin; maxillary and vomerine teeth present; a shovel-like, inner metatarsal tubercle present; finger- and toe-tips not dilated; toes with reduced webbing; lack of spinous processes on elbow and heel; manus lacking enlarged tubercles (Inger 1966; Manthey and Grossmann 1997; Parker 1934).

The new species can be diagnosed from other members of the genus as presently constituted in showing the following suite of characters: dorsum granular; a faint dermal fold across forehead; supratympanic fold indistinct; toe tips obtuse; webbing on toes basal; lateral fringes on Toes I, II, III and IV present; outer metatarsal tubercle present; pupil rounded; and dorsum olive with red spots and venter with a large area of red.

**Etymology.** The species name, *capsas*, alludes to the bright red and olive colour of the new species as capsicum is derived from ‘capsa’, Latin for box, in reference to the hollow, compartmental structure of pepper pods (see Szallasi and Blumberg 1999). We suggest the English name, ‘Bornean chili frog’ for the species.

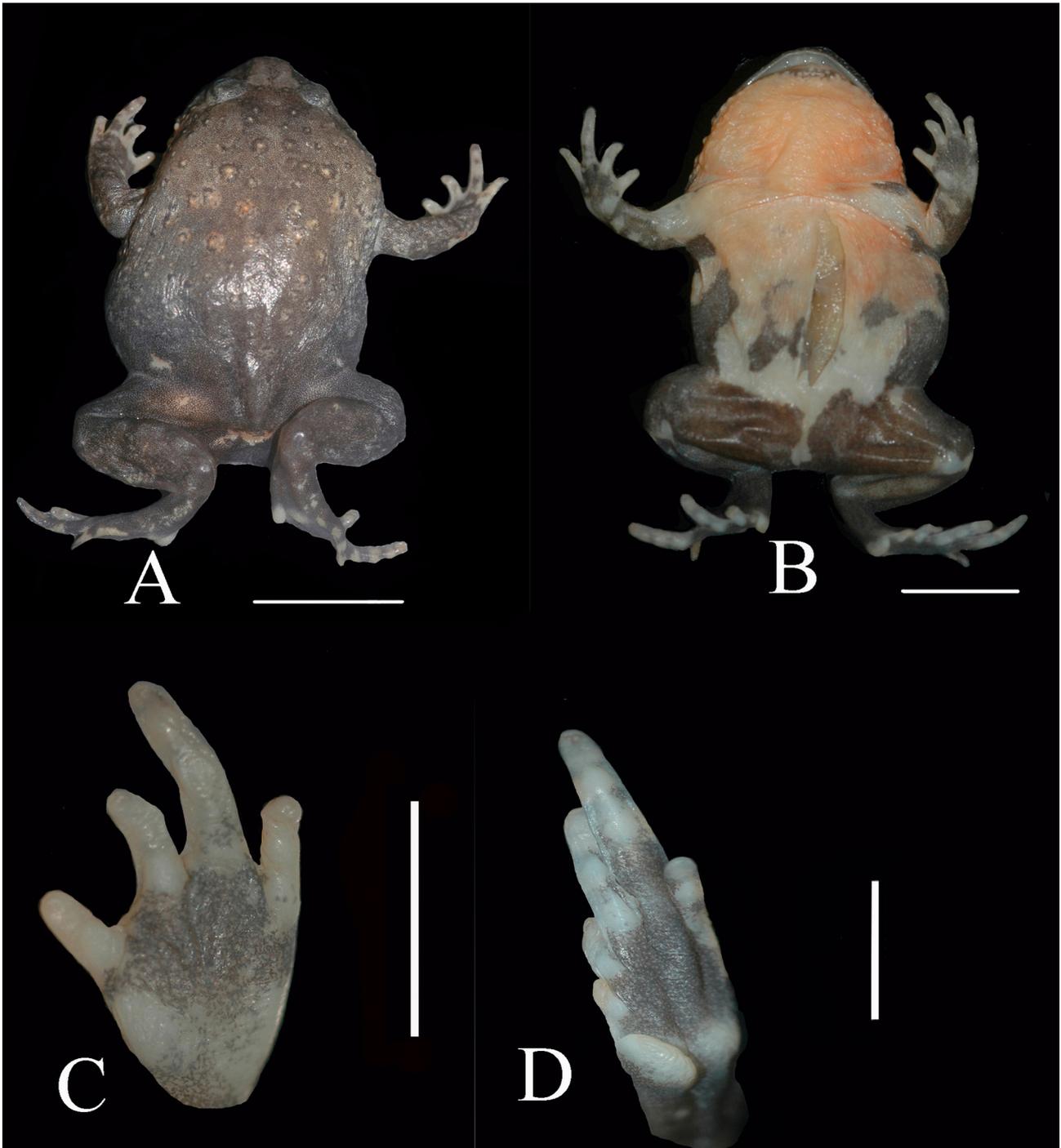
**Description of holotype (adult male).** A mid-sized species of *Calluella*, SVL 34.2 mm; body rounded, depressed; head wider than long (HW/HL ratio 1.92); snout obtusely pointed when viewed dorsally and obliquely truncate laterally; projecting slightly beyond mandible; nostrils rounded, laterally positioned, slightly nearer tip of snout than to eye (E–N/E–S ratio 0.47); internarial distance greater than distance from anterior margin of eye to nostril (IN/E–N ratio 1.55); eye small (ED/HL ratio 0.32); its diameter subequal to eye to nostril distance (ED/E–N ratio 1.18); interorbital width greater than upper eyelid width (IO/UE ratio 3.05); canthus rostralis obtuse; loreal region vertical; maxillary teeth present; a weak ‘W’-shaped notch (= symphyseal knob) on anterior edge of mandible; mouth extends to posterior corner of eye; choanae located against anterior of palate, partially visible when viewed from below; vomerine teeth set on two straight transverse ridges behind choanae, separated by a narrow mesial diastema; paired dermal ridges transversely across palate; tongue oval, smooth, slightly nicked apically, free for approximately half its length, not forming a pocket; pupil rounded, without clear orientation; tympanum not visible; oval, median subgular vocal sac.

Forelimbs short; fingers free of web or skin fringes; an indistinct metacarpal tubercle; relative length of fingers (measurements in parentheses, in mm): III (3.7) > II (3.2) > IV (3.1) > I (1.7); finger tips pointed; subarticular tubercles distinct, numbering one on Fingers I, II and IV and two on Finger III; one palmar tubercle at base of Finger I; nuptial pads absent on fingers; no enlarged glands on lower arm.



**FIGURE 1.** Live holotype of *Calluella capsa* **sp. nov.** (UNIMAS P0610). A. Dorsolateral view; B. Ventral view and C. Dorsolateral view of head.

Hind limbs short (TBL/SVL ratio 0.40); a few tubercles on dorsal surfaces of thigh and tibia; toes free of web; dermal fringes present on Toes I, II, III and IV; relative length of toes (measurements in parentheses): IV (9.7) > III (6.5) > V (5.2) > II (2.5) > I (1.7); toes obtuse; subarticular tubercles distinct, numbering one on Toes I, II and V, two on Toe III and three on Toe IV; a large (2.9 mm), crescentic inner metatarsal tubercle, that is larger than Toe I (1.7 mm), and a small, compressed outer metatarsal tubercles.



**FIGURE 2.** Preserved holotype of *Calluella capsa* sp. nov. (UNIMAS P0610). A. Dorsal view of body (scale marker = 10 mm); B. Body venter (scale marker = 10 mm); C. Left hand (scale marker = 5 mm) and D. Left foot (scale marker = 5 mm).

Dorsum granular, with well-developed, round warts that are concentrated medially, from the postorbital region, across scapular region, to mid-dorsum, those posteriorly raised as tubercles; warts also present on tympanic region; rest of dorsum granular, eyelids and upper surfaces of limbs smooth; an indistinct fold across interorbital region; indistinct supratympanic fold extends from posterior corner of orbit to end of gape; a fine dermal fold extends from mid-snout to the posterior of forehead; abdomen and inner side of thighs finely granular.

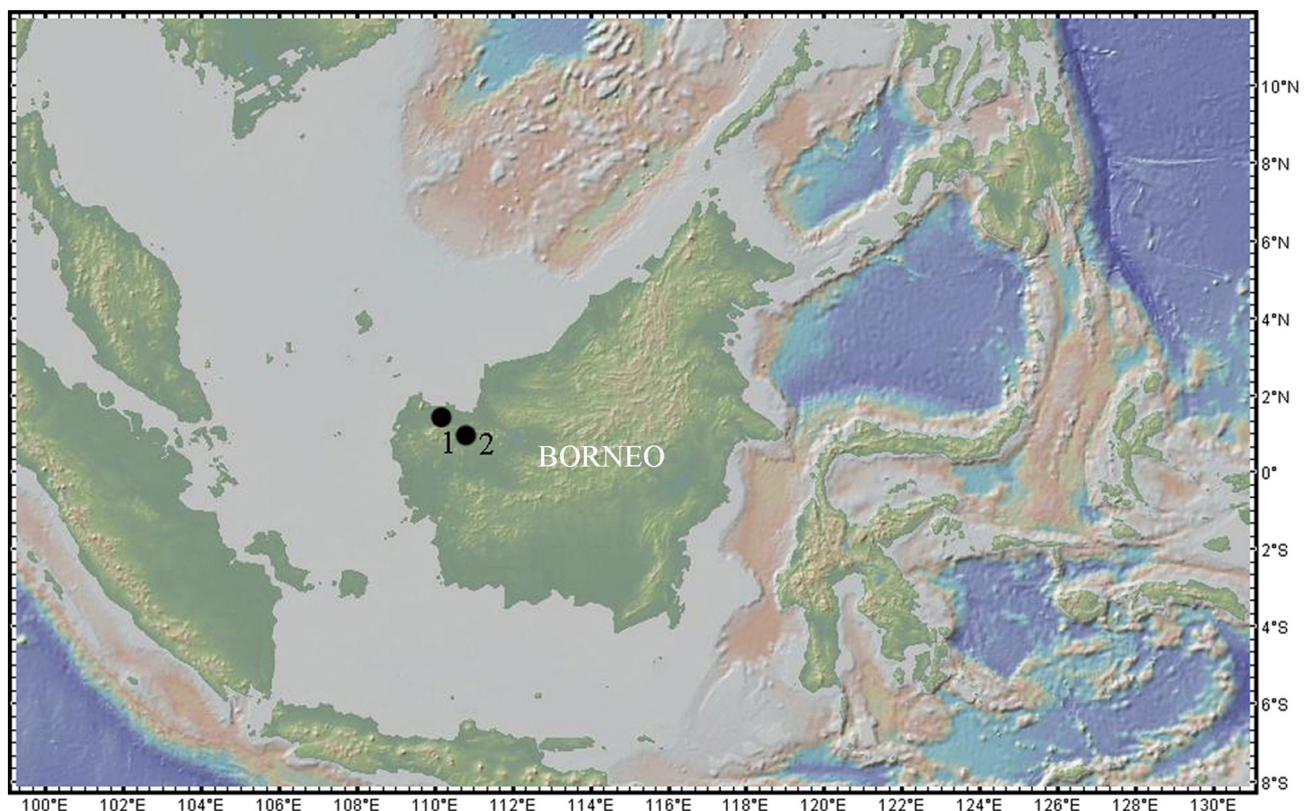
**Colour.** The overall impression is of an olive-and-red frog. The olive dorsum bears numerous bright red areas that surround wart-like structures, while the venter is brightly patterned with large areas of red and black. Formal colour description follows: in life, dorsum finely vermiculated Fuscous (Color #21), most tubercles pale-tipped and surrounded by irregular concentric rings of Spectrum Red (Color #11) and Flesh Ocher (Color #132D) areas.

Snout-tip with a pale pink stripe, which runs along a dermal fold to back of forehead. Upper surface of fore and hind limbs Fuscous (Colour #21), with indistinct, darker bands. Under surface of fore and hind limbs Sepia (Color #219). Dorsum of digits with Fuscous (Color #21) and Spectrum Red (Color #11) bands, these colours showing less contrast than on dorsum of body. Throat Spectrum Red (Color #11) to around midbelly, lower belly unpatterned cream. Irregular Sepia (Color #219) blotches on midbelly. A cream coloured patch in inguinal region. A red streak runs directly across area above vent. Pupil black, area surrounding pupil Salmon Color (Color #106); rest of iris Sulphur Yellow (Color #57), with dark network peripherally; an irregular, wavy dark line along periphery of orbit of eye present.

**Measurements (in mm) of holotype and paratype (in parentheses).** SVL 34.2 (36.0); HL 8.2 (10.1); HW 15.7 (17.0); HD 8.0 (9.2); BW 21.5 (17.8); TBL 13.8 (17.9); ED 2.6 (3.6); UE 2.0 (2.2); IN 3.4 (2.4); IO 6.1 (4.1); E-S 4.7 (5.0); E-N 2.2 (2.0); and A-G 10.7 (11.7).

**Ecological notes.** The holotype was found at around 1530 h, immediately preceding a heavy thunderstorm, from the edge of a fragmented patch of secondary submontane forest, surrounded by grasslands, at an elevation of 939 m asl. The locality lies at the upper reaches of Gunung Penrissen, a mountain range forming the boundary between Sarawak (Malaysia) and Kalimantan (Indonesia). About 20 species of frogs have been found at this elevational band (900–1100 masl) on Gunung Penrissen (Das and Pui, unpubl.). The paratype was found dead on the summit trail to Gunung Serapi, an isolated massif of the Matang Range, north of Gunung Penrissen. Das *et al.* (2007) reported on 55 species of amphibians from Matang Range but another five species have since been found in the area (Das, Haas and Pui, unpubl.).

The two localities where the types were found are on discontinuous mountain ranges (Fig. 3), separated by a distance of ca. 56 km (linear distance between the two localities estimated using <http://www.movable-type.co.uk/scripts/latlong.html>) of plains and the low, limestone hills of the Bau region. The known distribution thus suggests that the species may be more widespread in western Borneo, when further inventories of the poorly-known mountain systems of western Borneo are conducted.

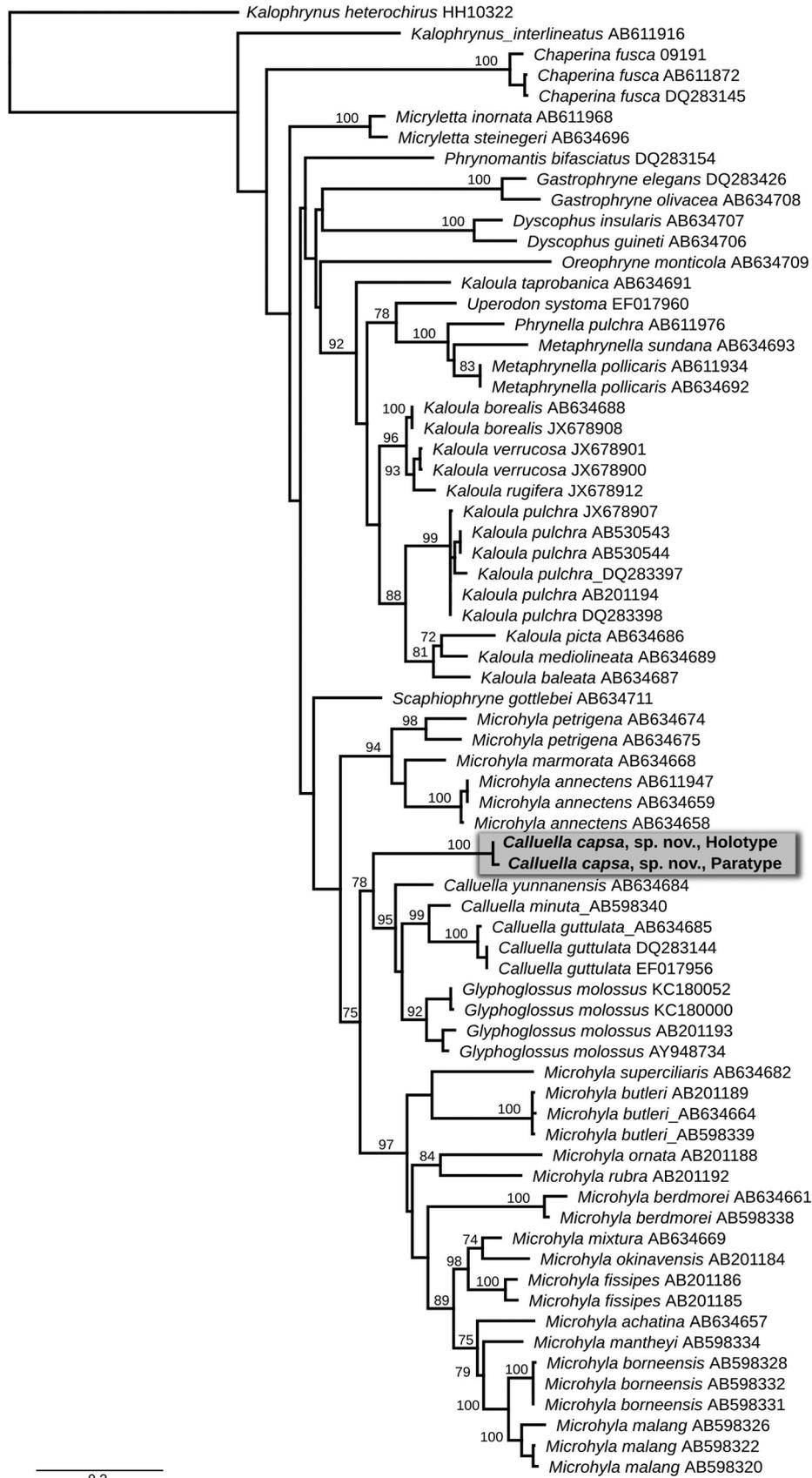


**FIGURE 3.** Map of Borneo and adjacent regions in south-east Asia, showing type localities of *Calluella capsa* sp. nov. at the Matang Range (1) and Gunung Penrissen (2) in Sarawak State, East Malaysia. Base map generated using GeoMapApp version 2 (Lamont-Doherty Earth Observatory, Columbia University).

**Morphological comparisons.** The new species from western Sarawak is compared with all known congeners, listing only opposing suites of characters for congeners: *Calluella brooksii* (Boulenger 1905), distribution: Bidi, Bau, as well as Kuching, western Sarawak (Malaysia) and one locality in north-central Kalimantan (Indonesia); see Inger *et al.* 2004: SVL 51–55 mm in males, 60–73.5 mm in females (Manthey & Grossmann 1997; Table 1), besides a larger adult size the following character states further distinguish *C. brooksii* from the new species; pupil vertically elliptical; outer metatarsal tubercle absent; interorbital fold absent; and dorsum tuberculate, with two dark stripes or rows of spots and flanks with small black dots; *C. flava* Kiew 1984, distribution: Gunung Mulu National Park, northern Sarawak, Malaysia, SVL 35 mm in the only specimen known (Manthey & Grossmann 1997), whose sex was unspecified, dorsum smooth; toes with expanded tips; outer metatarsal tubercle absent; dorsum orange-yellow, with a dark brown forehead; and flanks without dark blotches and without red bars; *C. guttulata* (Blyth 1856), distribution: eastern Myanmar, Thailand, Vietnam, Laos and south-western Cambodia, SVL 34–45 mm in males, 38–50 mm in females (Manthey & Grossmann 1997), dorsum smooth; webbing on Toe IV broad up to basal subarticular tubercle, reaching penultimate tubercle as a narrow sheath; and outer metatarsal tubercle absent; *C. minuta* Das *et al.* 2004, distribution: Peninsular Malaysia, interorbital fold absent; toe webbing broad to median subarticular tubercle; flanks and venter unpatterned; and dorsum tuberculate, with yellowish-brown, with darker variegation and a large, dark, central area; *C. smithi* (Barbour & Noble 1916), distribution: northern Sarawak and Sabah, SVL 37–39 mm in females; male size range remains unknown (Manthey & Grossmann 1997); dorsum smooth; interorbital fold indistinct; outer metatarsal tubercle absent; no red areas in gular region; and dorsum with a large, dark-centred blotch with laterally projecting branches and flanks with pink-edged black blotches; *C. volzi* (van Kampen 1905), distribution: known from two isolated localities, Tanjung Laut, and Sauraya, on the Alas River, from north-western and south-eastern Sumatra, respectively, both in Indonesia (Islandar & Mumpuni 2004; see also material examined in Appendix 1), SVL 31.3–34 mm, toe tips dilated; toes two-thirds webbed; outer metatarsal tubercle absent; subarticular tubercles present; distinct dermal fold in interorbital region typically present; dorsum tuberculate, with reddish-brown, with black spots; and venter lacks red pigmentation on gular and abdominal regions; and *C. yunnanensis* Boulenger 1919, distribution: Yunnan, Sichuan and Guizhou Provinces of south-western China, and the Fansipan Mountains of Viet Nam (Orlov *et al.* 2002), SVL 30.0–37.2 mm in males, 40.0–48.8 mm in females (Yang 1991), toe tips swollen, toe webbing between Toes III and IV reaching beyond level of distal tubercle of Toe III (Parker 1934); distinct interorbital fold present; dorsum tuberculate, pale pinkish-grey with traces of a dark lateral band from canthus rostralis to mid-flanks; and venter lacks red pigmentation on gular and abdominal regions. An additional species has been described in the genus- *Calluella ocellata* Liu (1950), from “Szekuaipa, Chaochiaohsien, Sikang, 7,800 feet” (currently, Sikuaiba, Zhaojue County, Sichuan Province, China). However, Liu and Hu (1961) placed the name in the synonymy of *C. yunnanensis* Boulenger 1919, despite its obvious morphological differences, including fully webbed toes (vs. toes with at least one phalange free of webbing) and small finger IV (vs. Finger IV > Finger I). *C. ocellata* differs from the new Bornean species in showing a completely webbed toes; Finger IV smaller than finger I; and a dark vinaceous grey dorsum and inguinal region with paired ocella.

Table 1 lists measurements and meristic data for adults of the genus *Calluella*.

**Phylogenetic Relationships.** The final alignment from MAFFT consisted of 857 bp of which 430 positions were variable and 370 were informative. The final ML Optimization Likelihood of the resulting tree is -11492.0. The holotype and paratype of *Calluella capsula* form a monophyletic clade that is morphologically diagnosable, and further, show a low genetic distance of 0.6%. The phylogenetic position of *C. capsula* as a basal branch within a clade consisting of the remaining species of *Calluella* and *Glyphoglossus* is well-supported (Fig. 4). *Calluella* is paraphyletic with respect to *Glyphoglossus*. This result is in agreement with Matsui *et al.* (2011), who presented a consensus tree showing *Glyphoglossus* within *Calluella*. Pyron and Wiens (2012) recovered a sister-relationship between *Glyphoglossus molossus* and *Calluella guttulata*. However, they had a single representative from the latter genus in their sample. These relationships recovered suggest paraphyly of the group currently allocated to the genus *Calluella*, the lineage also including *Glyphoglossus* that is clearly embedded in it. Should further investigations, with more intense sampling, especially of the members from the Asian mainland, revalidate our results and those of Matsui *et al.* (2011), it would lead to a revised taxonomy of the group, with the reallocation of members from *Calluella* to its older generic name, *Glyphoglossus*.



**FIGURE 4.** Phylogenetic relationships of *Calluella capsa* sp. nov. according to a RaxML-based Maximum Likelihood analysis of partial sequences of the mitochondrial 16S rRNA gene, node labels show the bootstrapping support obtained with 100 pseudoreplicates.

**TABLE 1.** Mensural and meristic data for *Calluella capsa* sp. nov., compared with congeneric species. References: 1. Male SVL (maximum, unless range given, in mm); 2. Female SVL (maximum, unless range given, in mm); 3. Supratympanic fold indistinct (0) or distinct (1); 4. Dorsum smooth or granular (0) or tuberculate (1); 5. Toe webbing absent (0), basal (1) or extensive (2); 6. Lateral fringes on toes absent (0) or present (1); 7. Outer metatarsal tubercle absent (0) or present (1); 8. Pupil shape vertical (0), horizontal (1) or rounded (2); 9. Tips of toes obtuse (0) or expanded (1); 10. Interorbital fold absent (0), indistinct (1) or distinct (2); 11. Dorsum ground colour olive (0), yellow (1) or brown (2); 12. Dorsum unpatterned (0), with small spots (1) or large dark central area (2); 13. Flanks unpatterned (0), with dark blotches (1) or with red bars (2); 14. Venter unpatterned or finely speckled (0), with dark spots or streaks (1) or with bright red gular and abdominal regions (2). In addition, '?' denotes an unknown character state; '/' denotes a multistate character; '-' denotes not applicable, \* denotes unknown sex.

Characters	<i>brooksii</i> western Sarawak, Borneo	<i>capsa</i> sp. nov. western Sarawak, Borneo	<i>flava</i> northern Sarawak, Borneo	<i>guttulata</i> Myanmar, Thailand, Laos, Vietnam	<i>minuta</i> Peninsular Malaysia	<i>smithi</i> northern Sarawak, Borneo	<i>volzi</i> Sumatra	<i>yunnanensis</i> southern China, Vietnam
1	51.0–55.0	34.2–36.0	35.25*	34.0	30.9–32.7	33.0	31.4	30.0–35.5
2	60–73.5	?	?	38.0	25.5	38.0–40.0	31.3 (34.0*)	40.0–48.8
3	0	1	0	0	1	?	1	1
4	1	0	0	0	1	0	1	1
5	1	1	1	1	2	1	2	2
6	1	1	1	1	1	?	1	1
7	0	1	0	0	1	0	1	1
8	0	2	?	2	2	1/2	1/2	2
9	0	0	1	0	0	0	1	1
10	0	1	1	0/1	0	2	1	?
11	1	0	1	0	1	2	2	2
12	1	1	1	2	2	1	1	2
13	2	2	1	0	0	1	1	0

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#### APPENDIX 1. Comparative material examined.

- Calluella brooksii*. UNIMAS 9422. Sama Jaya Nature Reserve, Sarawak, Kuching. Images of following specimen examined: BMNH 1903.11.24.3 (holotype). “Bidi, Sarawak”.
- Calluella flava*. Images of following specimen examined: BMNH 1978.1599 (holotype). “..kerangas forest in the FEG Kerangas Plot situated at 190 m above sea level on the trail from Camp 5 to Sungai Berar Camp” in “Gunung Mulu National Park, Sarawak”.
- Calluella guttulata*. ZRC A.9786–87; ZRC 1.9909; ZRC 1.9919–20. Cat Tien National Park, Vietnam; ZRC 1.116. Paknam Po, Nakhon Sawan Province, Thailand.
- Calluella minuta*. ZRC A.10888 (ex-DWNP A.0971, holotype) and FRIM 0579 (ex-DWNP A.0970; paratype), “from forest trail along Sungai Relau (04° 40' 46.3"N; 102° 03' 21.2"E), Merapoh, Taman Negara, Pahang State, Peninsular Malaysia, altitude 167 m ASL”; ZRC 1.2919 (paratype), “Kuala Tahan, Taman Negara, Pahang State, Peninsular Malaysia”.
- Calluella volzi*. NMBE 1018928, 1018929. Palembang, Sumatera, Indonesia.
- Calluella yunnanensis*. Images of following specimen examined: BMNH 1905.5.30.47, BMNH 1907.5.4.30 (two syntypes). “Yunnan Fou”.